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Effect of Instructional Module on Nurses' Performance and Patients' Outcomes Regarding High Alert Medications in Cardiac Care Units

Amal Fawzy Zaki Ali[1], Nadia Mohamed Taha[2] , Elham Hamad Mohamed[3], and Samah Mahmoud Mohamed[4]

1. Clinical Instructor at Technical Institute of Nursing, Zagazig University
2. Professor of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt
3. Assistant Professor of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt
4. Lecturer of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt

Abstract

High alert medications (HAMs) are medications that bear a significantly high risk of inducing substantial harm to patients if utilized incorrectly. Aim: The aim of this study was to evaluate the effect of instructional module on nurses' performance and patients' outcomes regarding HAMs in Cardiac Care Units. Design: A quasi experimental research design was utilized. Setting: This study was conducted at two Cardiac Care Units in cardiac and thoracic building of Sednawy Hospital, affiliated with Zagazig University Hospitals. Sample: A convenience sample of 40 nurses and a purposive sample of 40 patients. Tools: A structured interview questionnaire for nurses, nurses' practice observational checklists regarding HAMs, and patients' outcomes assessment questionnaire. Results: There were highly statistically significant differences between nurses' knowledge and practices concerning HAMs at pre and post intervention phase, as well as, post and follow-up phase at p-value<0.01. There was a highly statistically significant improvement in mean scores of patients' outcomes as regards HAMs after instructional module implementation compared to before. The significant positive predicating factors which affect nurses' practice score at post-intervention were knowledge score and qualification. Conclusion: There was a statistically significant improvement of nurses' knowledge and practice concerning HAMs after application of instructional module, which reflected on improved patients' outcomes through reduction in HAMs related complications. Recommendations: Conducting continuous training programs and seminars focused on HAMs to enhance nurses' performance and the overall quality of care provided to this patient group.

Keywords: High Alert Medications, Instructional Module, Nurses' Performance, Patients' Outcomes

Full length article ***Corresponding Author:** Amal Fawzy Zaki Ali, **e-mail:** amalehab1408@gmail.com

1. Introduction

High alert medications (HAMs) are those that carry a greater potential of causing adverse responses when accidentally delivered to patients in the emergency room (ER), intensive care units (ICUs), and cardiac care units (CCUs). The administration of medication involves several steps that all need careful consideration. Although errors involving these drugs are rare, they can have far more devastating effects on the seriously ill patient if they do happen. Furthermore, errors with these drugs have significantly more disastrous consequences for cardiac patients [1].

In the nursing profession, medication errors pose a serious challenge, especially when it comes to HAMs, which have a higher potential for serious harm or even death if not handled properly. These drugs include, but are not restricted to, benzodiazepines, anticoagulants, opioids, cardiovascular drugs, chemotherapeutic agents, and neuromuscular blocking agents [2].

Nurses have a critical role in the safe administration and regulation of HAMs because they are in charge of assessing patient needs, providing drugs appropriately, and monitoring for adverse effects. However, nurses' lack of understanding and practice with HAMs frequently results in medication errors with serious effects for patients' cardiovascular and hemodynamic functioning. Nurses must be informed of indications, dosages, contraindications, and adverse effects in order to provide safe and effective pharmacological therapy to patients. They must also assess each patient prior to administering a drug [3]. An instructional module is a self-contained unit of education that is created to accomplish certain learning objectives or aims. A range of educational resources and tasks, including readings, quizzes, multimedia, lectures, and assignments, are usually included. The learning module is typically arranged around a common theme or topic and can be given in a variety of modes, including online, face-to-face, and blended learning. A learning module's purpose is to provide students with

structured and interesting learning experiences that allow them to gain new knowledge, skills, and competencies [4].

Significance of the study:

High alert medications pose a high risk potential errors if the administered dose and method of administration were incorrect, such as intravenous (IV) inotropic medicine infusion, there is a high chance of errors in their administration, such as myocardial ischemia, which can cause hypotension in some circumstances. Aside from metabolic, cardiovascular, and dermatologic adverse effects, these sympathomimetic medicines may result in central nervous system activation, including tremors, restlessness, confusion, and psychosis [5].

It is estimated that a hospitalized patient experiences HAMs related adverse event every day. Furthermore, The Institute of Medicine Committee on Identifying and Preventing Medication Adverse Events estimates that at least 1.5 million preventable adverse drug events (ADEs) that happen annually in the United States [6]. In Egypt, the Egyptian Medication Errors Reporting System revealed that the most common HAMs complications were due to overdosing, incorrect administration, and medication neglect. The most common HAMs errors happened during prescription (54%), administration (16%), and incorrect dosage (20%) [7]. So, this study was conducted to evaluate the effect of instructional module on nurses' performance and patients' outcomes regarding high alert medications in Cardiac Care Units.

Aim of the study:

The present study aimed to evaluate the effect of instructional module on nurses' performance and patients' outcomes regarding high alert medications in Cardiac Care Units.

Through the following specific objectives:

- Assess nurses' knowledge and practice regarding high alert medications.
- Determine patients' complications related to high alert medications.
- Design, implement, and evaluate the effect of instructional module on nurses' performance and patients' outcomes regarding high alert medications in Cardiac Care Units.

2. Research hypotheses:

H1: Nurses' knowledge regarding high alert medications will exhibit statistically significant increase after implementation of instructional module than before.

H2: Nurses' practice regarding high alert medications will demonstrate statistically significant enhancement after implementation of instructional module than before.

H3: Patients' outcomes will demonstrate statistically significant improvement after implementing instructional module for nurses.

Operational definitions:

High alert medications included adrenaline, noradrenaline, dopamine, digoxin, potassium chloride, calcium chloride, anticoagulants drugs (heparin), narcotics, and sedatives.

Instructional module refers to a set of instructional activities that allow nurses to update their knowledge and practice for effective performance through applying module concerning HAMs.

Nurses' performance refers to nurses' knowledge and practice regarding HAMs.

Patients' outcomes are complications experienced by patients that related to HAMs. in other words, the results of instructional module implemented to nurses which reflected on patients' complications related to HAMs.

Subjects and Methods:

Research Design:

A quasi-experimental research design comprising both pre-test and post-test was executed to accomplish the study's aim. A quasi experimental research design is a type of research design that seeks to establish a cause and effect relationship by collecting data from research subjects before and after intervention is introduced [8].

Research Setting:

The current study was carried out at two Cardiac Care Units in Cardiac and thoracic building of Sednawy Hospital, affiliated with Zagazig University Hospitals. The first CCU is located at 3rd floor of cardiac and thoracic building, while the second CCU is located at 4th floor in the same building. Each CCU contained a room for medical staff, a room for nursing staff, a room for lectures equipped with data show, a room for patients including ten beds, ten mechanical ventilators, ten patients' monitors, two electrocardiograph devices, and two emergency cars.

Subjects:

Nurses: A convenience sample of 40 nurses working in CCUs with at least 6 months of experience dealing with HAMs, and accepted to participate in this study.

Patients: A purposive sample of 40 patients receiving HAMs was allocated for this study. The sample size estimation is based on census report of admissions in CCUs of Sednawy Hospital using program to estimate power and sample size, yielding a power analysis of 80%. The projected sample size was 40 patients in the previous mentioned settings. The formula for calculating sample size was

$$N = \frac{N}{1+N(e)2}$$

Where n = Sample size

N= Total population

e = Margin error 0.05

Inclusion criteria: both sexes, aged 20 to 60 years old, consciousness, receiving HAMs, able to communicate, and agreed to engage in the study. **Exclusion criteria:** end stage of chronic diseases such as renal failure and hepatic encephalopathy, history of peripheral vascular diseases, or presence of psychosocial problems such as psychiatric and mental disorders that impair patients to communicate.

Tools of data collection:

Tool I: A Structured Interview Questionnaire for Nurses: It was constructed by the researcher after reviewing of related literatures and experts comments for content validity. It has been altered to plain Arabic language to avoid misinterpretation. The questionnaire consisted of two main parts as follows:

Part I: Nurses' Demographic characteristics: It composed of seven items as nurses' age, gender, marital status, educational level, years of experience in nursing profession, years of experience in CCUs, and previous training courses regarding HAMs.

Part II: Nurses' knowledge assessment questionnaire regarding HAMs (Pre, Post, Follow-up): It was utilized to assess nurses' knowledge regarding HAMs; it was implemented as pre and post implementation of instructional module, as well as, in the follow-up phase. It was adapted from [6, 9, 10]. It involved 113 questions in the form of multiple choice questions (MCQ), covering the following five sections:

Section I: Nurses' knowledge regarding general questions about HAMs: It composed of 8 MCQ about definition of HAM, drugs are considered high-risk, common mistakes when giving HAMs, avoid mistakes when dealing with similar HAMs, storing HAMs, oral order about HAM in emergency, etc.

Section II: Nurses' knowledge regarding Inotropic drugs (adrenaline, noradrenaline, dopamine and digoxin): It contained 40 MCQ regarding types of inotropic drugs, purpose of inotropic drugs, method for injecting inotropic drugs, side effects, alternative name for adrenaline, purpose of adrenaline, complications of adrenaline, methods of administrating adrenaline in cases of cardiac arrest, etc.

Section III: Nurses' knowledge regarding potassium chloride and calcium chloride: It involved 23 MCQ as regards nursing action, precautions when giving potassium chloride, normal range of potassium level, how to treat excess potassium, potassium chloride as a high-alert medication, nursing intervention, symptoms, contraindications to potassium chloride, etc.

Section IV: Nurses' knowledge regarding anticoagulants: It featured 14 MCQ about cases should not be given anticoagulants, instructions, signs and symptoms, conditions for which anticoagulant therapy is utilized, contraindications, complications, drugs interact with anticoagulants, etc.

Section V: Nurses' knowledge regarding sedatives and opioids: It composed of 28 MCQ about indications, side effects, rate at which sedative drugs are given, conditions requires close monitoring, withdrawal symptoms, role of the nurse before administering any sedative, etc.

The scoring system:

Response scores were assigned as follows: Each question was assigned one for each correct answer and zero for incorrect answer or don't know. The scores of each section were summed-up and divided by the numbers of elements to calculate a mean score. The total mean scores of knowledge were calculated as the mean of all sections. Means and standard deviations were then calculated for the studied nurses in the pre, post, and follow-up phases and then compared based on statistical analysis.

Tool II: Nurses' Practice Observational Checklists regarding HAMs (Pre, Post, Follow-up): It was utilized to assess nurses' practices regarding HAMs. It was adopted from [6, 9-11]. It constituted 291 items separated into 9 checklists as the following:

Adrenaline infusion observational checklist included 32 items.

Noradrenaline infusion observational checklist composed of 33 items.

Dopamine infusion observational checklist contained 32 items.

Calcium chloride infusion observational checklist involved 32 items.

Potassium chloride infusion observational checklist had 32 items.

Digoxin intravenous observational checklist consisted of 28 items.

Anticoagulant therapy (Heparin) observational checklist had 34 items.

Sedatives medications observational checklist included 34 items.

Narcotics medications observational checklist contained 34 items.

The scoring system:

Each item was marked as "done," and "not done." These were scored "1" and "0", respectively, with a higher score indicating better practice. The mean score was calculated by adding the scores for each technique and dividing them by the number of steps. The total mean scores of practices were calculated as the mean of all techniques. Means and standard deviations were then calculated for the studied nurses in the pre, post, and follow-up phases and then compared based on statistical analysis.

Tool III: Patients' Outcomes Assessment Questionnaire: It was designed by the researcher after examining related literatures and experts comments for content validity. It comprised three main parts, as follows:

Part I: Patients' Demographic Characteristics: It incorporated 5 components including age, gender, occupation, marital status, and residence.

Part II: Patients' Medical Data: It involved 3 questions about patients' medical data as regards medical diagnosis, associated chronic diseases, and family history of chronic diseases.

Part III: Patients' High Alert Medications related Complications Assessment Questionnaire (Pre/ Posttest): It was adapted from [12-14]. It involved 28 questions to evaluate patients for the development of the most common complications associated with HAMs two times; pre implementation of instructional module for nurses and post implementation of instructional module for nurses. It included hypertension, hypotension, tachycardia,

bradycardia, difficulty breathing, chest pain, bleeding, bruising, hyperkalemia, hypocalcemia, hypomagnesemia, severe headache, blurred vision, tremors, numbness, respiratory depression, etc. Each complication was identified using both subjective and objective criteria which were verified by doctor.

The scoring system:

Each confirmed complication was scored as "1" for present or "0" for absent. The overall mean scores of complications were determined and then compared established on statistical analysis.

Content validity and Reliability:

Content validity seeks to examine the various components of measuring instruments to see whether these tools accurately assess the specific constructs for which they were precisely designed. It was tested to determine whether the tools' subjects addressed the study's aim. Instruments were revised by five experts "3 professors and 2 assistant professor of medical surgical nursing and cardiology staff " who examined the tools' content for clarity, relevancy, simplicity of execution, understanding, and comprehensiveness". Minor changes were made based on their feedback, and the final form was created. The tools' reliability was assessed using the internal consistency method. The Cronbach's alpha reliability coefficient was "0.868, 0.863, and 0.873, respectively" for "a structured interview questionnaire for nurses, nurses' practice observational checklists regarding HAMs, and patients' outcomes assessment questionnaire".

Administrative design:

The study's purpose was explained to the dean of nursing faculty, director of Zagazig University Hospitals, head of CCUs, and nursing heads, who all granted the required official approvals before conducting the study. Furthermore, verbal consents from both nurses and patients were obtained in order to take part in the study after being informed of its nature, objectives, and benefits.

Ethical considerations:

Prior to initiating the study, an ethical approval was secured from the Research Ethics Committee of Nursing Faculty, Zagazig University. Each studied participant was informed about the study's nature, its objectives, and benefits before giving their consent, which was obtained prior to the first interview. Nurses and patients were informed that withdrawal was permitted without explanation. All data was coded to ensure subjects' confidentiality and anonymity.

Pilot study:

Prior to data collection, a pilot study was conducted to assess the clarity, application, feasibility, and relevance of data collection tools. It also help to clarify any potential barriers to data collection and estimate the time required to fill out study tools. The researcher chose 10% of the total study participants (4 nurses and 4 patients) to test the used tools. Because the tools had not been modified, nurses and patients who participated in the pilot trial were included in the study sample.

Field work:

The study was implemented over a six-month period, from the beginning of January 2023 to the end of June 2023, after securing all relevant official permissions. The fieldwork was carried out through the following phases:

Preparatory phase:

This phase encompassed formulation of data collection tools and advancement of instructional module by the author, based on a comprehensive examination of contemporary, relevant scholarly articles.

Assessment phase:

Prior to commencement of data collection, the researcher fostered an open and effective line of communication with the study participants, comprising both nurses and patients, by introducing himself and outlining the nature and purpose of the study after getting approvals to proceed the study. The researcher executed an initial assessment of nurses' knowledge and practices related to HAMs individually at CCUs with the aid of data collection tools (Tool I & Tool II). Tool I required approximately 25-30 minutes for completion by each nurse, however Tool II necessitated around 35-40 minutes for the observation of each nurse to obtain the requisite data. The amassed data facilitated the researcher in formulating the instructional module content and acted as a baseline data.

Furthermore, the researcher conducted one-on-one interviews with each patient at CCUs prior to implementing the instructional module, using the data collection tool (Tool III) as a pre-test, to gather baseline data pertaining to demographic characteristics, medical data, and patients' outcomes. Tool III required roughly 15-20 minutes to complete from each patient to gather the essential data.

Planning phase:

This phase began with the development of the instructional module based on nurses' needs as determined by the assessment phase, as well as, a study of the most current and pertinent literature. objectives and expected outcomes were developed to improve nurses' knowledge and practice as regards HAMs based on instructional module execution priorities. Additionally, the researcher created an illustrative instructional module handout in easy-to-read Arabic language to assist nurses in assimilating and activating the supplied knowledge in order to fulfill the study's aim.

Lectures, group discussions, demonstration, and re-demonstration were selected as training approaches to support small groups instructions. PowerPoint presentation, video-films through lap top or cell phone, colored posters, and illustrative pictures were utilized as teaching media.

Implementation phase:

The instructional module was executed for nurses in the form of sessions held at the study settings during morning and afternoon shifts, three days per week. The researcher split nurses into small groups of four to five nurses in each. The instructional module content was presented across nine consecutive sessions encompassing both theoretical and practical portions. Lectures and group discussions were used to handle the theoretical portion, while demonstrations and re-demonstrations were used for

the practical portion. Each session lasted approximately 30-45 minutes. Each session opened with an overview of the previous session's content as well as the goals for the next session. Throughout the sessions, strategies for improving learning included motivation, encouragement, and active engagement. All nurses under the study received an illustrative handouts.

The 1st session served as an orientation presenting the instructional module's purpose and scope, as well as, its overarching objectives, educational strategies, learner's performance, and assessment methods. This was subsequently complemented by four sessions focused on the theoretical portion. **The 2nd session** discussed HAMs definition, its classification, common associated risk factors, and examples of HAMs labels. **The 3rd session** addressed an overview of generic name, indications, contra-indications, adverse effects, methods of administration, drug interactions, instructions, precautions, and storage as regards adrenaline, noradrenaline, dopamine, and digoxin. **The 4th session** focused on potassium chloride, calcium chloride, anticoagulants, and sedatives and narcotics involving their types, indications, contra-indications, adverse effects, methods of administration, drug interactions, instructions, precautions, storage, and overdose symptoms. **The 5th session** covered policies for handling HAMs, look-alike and sound-alike medications, as well as, nurses' role in administrating HAMs.

The practical portion incorporated 4 sessions; **the 6th session** dedicated to demonstration and re-demonstration of adrenaline and noradrenaline administration via infusion encompassing preparation, administration, post administration, and documentation phases. **The 7th session** for demonstration and re-demonstration of dopamine by infusion and digoxin by intravenous administration including preparation, administration, post administration, and documentation phases. **The 8th session** for demonstrating and re-demonstrating potassium chloride and calcium chloride by infusion administration involving preparation, administration, post administration, and documentation phases. **The 9th session** for demonstration and re-demonstration of anticoagulant (Heparin) by subcutaneous injection, as well as, sedatives and narcotics administration including preparation, administration, post administration, and documentation phases.

Evaluation phase:

Each nurse in the study underwent three evaluations utilizing the same data collection tools (Tool I & Tool II) to evaluate nurses' knowledge and practice as regards HAMs. This was carried out before instructional module implementation (pre-test), immediately after instructional module implementation (post-test), and one month after instructional module implementation (follow-up). The findings of post-test and pre-test, as well as, follow-up and post-test were compared.

Furthermore, each patient in the study was evaluated twice utilizing the same data collection tool (Tool III). This was carried out prior to instructional module implementation (pre-test) and immediately after the completion of the instructional module implementation (post-test) to evaluate the effect of instructional module implementation on patients' outcomes through assessing complications related with HAMs.

Statistical Design:

The gathered data was arranged, tabulated, and subjected to statistical analysis with Statistical Package for Social Science (SPSS) version 25 for Windows, ran on IBM compatible computers. Quantitative data were expressed as mean±SD, whereas qualitative data were presented as frequencies and percentages. Paired T test (t) used to compare between means of quantitative variables as the test of significance. The Spearman correlation coefficient was used to analyze the relationships between study variables, (+) sign indicates direct correlation & (-) sign indicates inverse correlation. Multiple linear regression (stepwise) was used to assess the existence of statistical relationships between independent factors and the dependent variable, as well as, its intensity with direction. Cronbach's Alpha was used to determine the reliability of the study tools. A significant level value was considered when $p < 0.05$ whereas a highly significant level value was considered when $p < 0.01$. No statistical significance difference was considered when $p > 0.05$.

3. Results:

Table (1): Shows that the ages of (80.0%) of the studied nurses were 23-<33 years old with $\bar{x}$ S.D (28.82±5.70), (70 %) of them were females and had less than 3 years of experience in CCUs with $\bar{x}$ S.D (2.87± 1.24). Besides, (55%)of them were married, (42.5%) of them held Nursing Technical Institute, (92.5%) of them had less than ten years of experience in nursing profession with $\bar{x}$ S.D (4.70± 5.21), and all of studied nurses (100.0%) didn`t attend any previous training courses regarding HAMs.

Table (2): Displays that there were highly statistically significant differences between nurses' knowledge concerning HAMs at pre and post intervention phase with $\bar{x}$ S.D (59.12±11.99 & 169.37±8.22, respectively) at p-value<0.01, as well as, post and follow-up phase with $\bar{x}$ S.D (169.37±8.22 & 147.95±12.58, respectively) at p-value<0.01.

Table (3): Denotes that there were highly statistically significant differences between nurses' practice regarding HAMs at pre and post intervention phase with $\bar{x}$ S.D (68.45±13.05 & 266.02± 7.21, respectively) at p-value<0.01, as well as, post intervention and follow-up phase with $\bar{x}$ S.D (266.02± 7.21 & 233.42±13.31, respectively) at p-value<0.01.

Table (4): Clarifies that there was a highly statistically significant positive correlation between nurses' total knowledge and their total practice in respect to HAMs at post and follow-up phase at p-value<0.01.

Table (5): Identifies that ages of (52.5%) of the studied patients were less than 57 years old with $\bar{x}$ S.D (51.80 ± 8.07) and (57.5%) of them were males and from rural areas. As well, (55.0% and 65.0 %) were working and married, respectively.

Table (6): Illustrates that (25.5 %) of studied patients had congestive heart failure and NSTEMI. Moreover, all of the studied patients (100.0%) had heart diseases and family history of hypertension. In addition to (72.5%) of them had family history of heart diseases.

Table (7): Demonstrates a significant improvement in mean scores of patients' outcomes as regards HAMs after implementing the instructional module and this

improvement was highly statistically significant differences at p-value<0.01.

Table (8): Explores a statistically significant negative correlation between the studied nurses' knowledge and patients' outcomes at post intervention at p-value<0.05.

Table (9): Clarifies stepwise multiple linear regression for predicting factors which affect practice score among studied nurses at post program. According to this table, knowledge score and qualification are the significant positive predicating factors of nurses' practice score at post-intervention.

4. Discussion:

As regards demographic characteristics of the studied nurses, the current study results revealed that majority of nurses were under the age of 33 years old and more than two thirds of them were female and had less than three years of experience in CCUs. Furthermore, more than half of them were married, more than two fifths possessed Nursing Technical Institute, most of them had less than ten years of experience in nursing profession, as well as, all of them didn't attend any previous training courses in respect to HAMs which could be attributed to work load, lack of time in CCU, and lack of training courses throughout hospital management. These results were supported by Farouk et al [1], who demonstrated that majority of studied nurses' ages were less than 33 years, half of them were graduated from Nursing Technical Institute and majority if them didn't participate in training programs as regards HAMs. Also, these findings was in agreement with Zyoud et al [15], who found that majority of studied nurses less than 33 years old, had less than10 years of experience in nursing profession, and had less than 5 years of experience in ICU. These findings were at odds with Shebl et al [16], which showed that most of the studied nurses had bachelor`s degree.

According to nurses' knowledge in respect to HAMs, the present study proved that there were highly statistically significant differences between nurses' knowledge concerning HAMs at pre and post phase, as well as, post and follow-up phase. additionally, there was a significant increase in nurses' knowledge post intervention with slight decline in follow-up phase compared to pre-intervention. According to the researcher's opinion, these findings reflected the effective influence of the instructional module on nurses' knowledge regarding HAMs and their successful participation through the study phases. Furthermore, simplification of well-presented information by suitable educational aids increased their interest and desire to acquire knowledge. These findings were in harmony with the results of Mohammed et al [17], who reported a highly statistically significant increase in nurses' total knowledge scores related to HAMs post educational guidelines implementation than before. furthermore, in the same line Hoda and Sara [7], who indicated that there was a highly statistically significant difference between nurses' total knowledge scores as regards HAMs at pre and post-test. Moreover, these study results were consistent with a study done by Ltheeth & Abbas [18], who reported that there were a highly statistically significant differences between nurses' knowledge at pre, post, and follow-up phase.

Concerning nurses' practice as regards HAMs, the current study findings pointed to that there were highly statistically significant differences between nurses' practice as regards HAMs at pre and post phase, as well as, post and follow-up phase. In addition, there was a significant improvement in nurses' practice post intervention with slight decline in follow-up phase compared to pre-intervention. According to the researcher's opinion, these findings reflected that instructional module achieved its purpose in improving nurses' practices regarding HAMs as it was implemented according to nurses' needs. In addition, highly interest of nurses in acquiring practice when engaged in the instructional module. These findings were steady with the results of Farouk et al [1], who concluded that there were highly statistically significant differences in nurses' practice regarding preparation, administration, monitoring, and documentation of HAMs at pre, post, and follow-up phase. Also, these results agreed with Abu Hussein et al [19], who proved that nurses' practices were improved after implementing the program compared to before the program. As well, these findings in congruent with Yousef et al [6], who represented that there were high statistical significant differences between pre-test, post-test and three months post-test in nurses' total mean practices score.

The current study findings identified that there was a highly statistical significant positive correlation between nurses' total knowledge and their total practice in respect to HAMs at post and follow up phase. From the researcher's point of view, this result might be due effect of instructional module on improving nurses' knowledge and practice regarding HAMs. This result corroborated those of Abd-Elrahman et al [20],who displayed that there was statistically significant correlation between total knowledge and practice of studied nurses during immediately post-program and follow up phase. Moreover, this result was in harmony with Mohanty [21], who proved that there was statistically significant correlation between nurses' total knowledge score and total practice score during post-program phase and follow up.

In respect to demographic characteristics of the studied patients, the present study results illustrated that more than half of the studied patients were more than 54 years old, male, working, and from rural areas. In addition, less than two thirds of them were married. These findings agreed with Aradhya et al [22], who found that slightly more than third of their patients' age was 54 years old. As well, similarly with Safaie et al [23], who stated that half of studied patients' ages were 56 years old and more.

In relation to medical data of the studied patients, the findings clarified that the most common diagnosis was congestive heart failure and NSTEMI, all studied patients had associated heart diseases and family history of Hypertension. In addition to more than two thirds of them had family history of heart diseases. These findings were in the same way with Rizkifani et al [24], who concluded that majority of patients had congestive heart failure and NSTEMI. As well, these results were in line with Bono et al [25], who found that majority of studied patients had congestive heart failure and NSTEMI and all them suffered from heart diseases. Also, these results were similar to that of Metwaly & Zatton [26], who reported that majority of

the studied patients had family history of heart diseases and hypertension.

Pertaining to total mean scores of the studied patients' outcomes regarding HAMs, the present study findings demonstrated that there was highly statistically significant improvement in patients' outcomes regarding HAMs between pre and post implementation of instructional module. According to the researcher's opinion, these findings reflected the effective effect of instructional module implemented to studied nurses' in decreasing patients' complications related to HAMs. This finding was in harmony with Esfahani et al [27], who exhibited that there were statistically significant improvements in reduction of adverse medication errors and events regarding administration of high risk drugs.

The current study demonstrated that there was a statistically significant negative correlation between the studied nurses' total knowledge and patients' outcomes at posttest. This indicated that improvement of nurses' knowledge in post phase causes improvement of patients' outcomes. The current finding was in harmony with Aysha & Ahmed [28], who identified that, there was a statistically significant negative correlation between nurses` total knowledge and patient outcomes. Furthermore, similarly with Woolley [29], who mentioned that there was statistically significant negative correlation between the studied nurses` total knowledge and patient complications post program.

The current study results revealed that nurses' knowledge scores and qualification are the significant positive predicating factors of nurses' practice scores at post intervention. This result was consistent with Labib et al [30], who indicated that qualification of nurses and knowledge had a high effect on their practice regarding HAMs. Also, these results were disagreed with the study conducted by Hoda & Sara [7], who reported significant negative correlation between nurses' knowledge scores and qualifications with practice.

Table (1): Percentage and Frequency Distribution of Demographic Characteristics of the Studied Nurses (n=40).

Demographic characteristics	No.	%
Age		
23-<33	32	80.0
33-<43	5	12.5
≥43	3	7.5
Mean ±SD	28.82± 5.70	
Range	23-46	
Gender		
Female	28	70.0
Male	12	30.0
Marital status		
Married	22	55.0
Not married	18	45.0
Educational level		
Postgraduate Studies	9	22.5
Bachelor of Nursing	7	17.5
Health Technical Institute	0	0.0
Nursing Technical Institute	17	42.5
Diploma in Nursing	7	17.5
Experience in nursing profession (Year)		
1<10	37	92.5
10<20	1	2.5
≥20	2	5.0
Mean ±SD	4.70±5.21	
Range	1-24	
Experience in Cardiac Care Units (Year)		
<3	28	70.0
≥3	12	30.0
Mean ±SD	2.87±1.24	
Range	1-5	
Previous training courses regarding HAMs		
Yes	0	0.0
No	40	100.0

Table (2): Total Mean Scores of Studied Nurses' Knowledge Regarding HAMs throughout Pre, Post, and Follow-up Phases (n=40).

Items	Pre	Post	Follow-up	P1	P2
	Mean± SD				
General knowledge regarding HAMs	5.55± 3.03	16.72± 1.71	12.85± 2.89	**0.001****	**0.001****
Inotropic drugs	15.62± 5.48	49.00± 2.75	43.82± 4.23	**0.001****	**0.001****
Potassium chloride and calcium chloride	12.17± 4.92	36.90± 2.71	32.77± 3.56	**0.001****	**0.001****
Anticoagulants	9.02± 3.40	24.72± 2.13	21.80± 2.36	**0.001****	**0.001****
Sedatives and opioids	16.75± 4.92	42.02± 3.34	36.70± 3.74	**0.001****	**0.001****
Total Knowledge Scores	**59.12± 11.99**	**169.37± 8.22**	**147.95± 12.58**	**0.001****	**0.001****

Paired t-test was used **: Highly statistically significant at ($p<0.01$)

p^1: for comparison between pre-intervention and post-intervention.

p^2: for comparison between post-intervention and follow-up phase.

Table (3): Total Mean Scores of Studied Nurses' Practice Regarding HAMs throughout Pre, Post, and Follow-up Phases (n=40).

Items	Pre	Post	Follow-up	P1	P2
	Mean± SD				
Adrenaline infusion	8.22± 2.15	27.20± 2.46	23.85± 2.39	**0.001****	**0.001****
Nor adrenaline infusion	9.37± 2.40	30.22± 1.77	26.92± 2.39	**0.001****	**0.001****
Dopamine infusion	9.37± 2.40	29.12± 1.85	25.15± 2.37	**0.001****	**0.001****
Calcium chloride infusion	11.10± 1.93	28.05± 2.33	25.42± 2.76	**0.001****	**0.001****
Potassium chloride infusion	7.80± 2.75	29.17± 1.31	26.00± 2.68	**0.001****	**0.001****
Digoxin (intravenous route)	5.95± 2.86	25.45± 1.56	23.05± 2.63	**0.001****	**0.001****
Anticoagulant drugs (Heparin)	7.00± 2.11	33.42± 1.87	29.72± 3.21	**0.001****	**0.001****
Sedatives medications	4.65± 3.30	31.55± 1.76	26.47± 2.44	**0.001****	**0.001****
Narcotics (opioids) medications	4.97± 2.85	31.82± 1.44	26.82± 2.61	**0.001****	**0.001****
Total Practice Scores	**68.45±13.05**	**266.02± 7.21**	**233.42±13.31**	**0.001****	**0.001****

Paired t-test was used **: Highly statistically significant at ($p<0.01$)

p^1: for comparison between pre-intervention and post-intervention.

p^2: for comparison between post-intervention and follow-up phase.

Table (4): Correlation between Studied Nurses' Knowledge and Practice throughout Pre, Post, and Follow-up Phases (n=40).

Items	Total Practice					
	Pre		Post		Follow-up	
Total Knowledge	**R**	**P**	**R**	**P**	**R**	**P**
	0 .072	0 .658	0 .475	0.001**	0 .550	0.001**

r: Spearman correlation coefficient test Non-significant at ($p>0.05$) **: Highly statistically significant at ($p<0.01$)

Table (5): Percentage and Frequency Distribution of Demographic Characteristics of the Studied Patients (n=40).

Demographic characteristics	No.	%
Age (year)		
34 – 44	9	22.5
44 – 54	10	25.0
> 54	21	52.0
Mean± SD	51.80 ± 8.07	
Range	34 – 60	
Gender		
Male	23	57.5
Female	17	42.5
Occupation		
Working	22	55.0
Not working	18	45.0
Marital Status		
Married	26	65.0
Not Married	14	35.0
Residence		
Urban	17	42.5
Rural	23	57.5

Table (6): Percentage and Frequency Distribution of the Studied Patients According to their Medical Data (n=40).

Items	No.	%
Diagnosis		
STEMI	5	12.5
Aortic aneurysm	3	7.5
Arterioventricular block	2	5.0
Atrial fibrillation	2	5.0
Cardiogenic pulmonary edema	3	7.5
Congestive heart failure	10	25.5
NSTEMI	10	25.5
Unstable Angina	3	7.5
Wellen`s B	2	5.0
Associated chronic diseases*		
Hypertension	23	57.5
Cancer	11	27.5
Heart diseases	40	100.0
Diabetes	0	0.0
Liver diseases	0	0.0
Renal diseases	2	5.0
Family history of chronic diseases*		
Hypertension	40	100.0
Cancer	23	57.5
Heart diseases	29	72.5
Diabetes	26	65.0
Liver diseases	22	55.0
Renal diseases	20	50.0

(*) select more answer

Table (7): Total Mean Scores of Studied Patients' Outcomes Regarding HAMs at Pre and Post Intervention (n=40).

Items	Pre-intervention Mean± SD	Post-intervention Mean± SD	T	P-value
Total Patients' outcomes	23.35±1.95	4.90±2.42	**39.880**	**0.001****

t= Paired T-test **: Highly statistically significant at (p<0.01).

Table (8): Correlation between Total Studied Nurses' Knowledge and Practice and Total Patients' Outcomes at Pre and Post Intervention (n=40).

Items	Total Patients' Outcomes			
	Pre		Post	
Total Nurses' Knowledge	R	P	R	P
	-0 .014	0 .929	-0.377	0.017*
Total Nurses' Practice	-0.002	0 .989	-0.165	0 .308

r: Spearman correlation coefficient test Non-significant at P (p>0.05) *: Significant at (p<0.05)

Table (9): Stepwise Multiple Linear Regression for Predicting Factors which Affect Practice Score among the Studied Nurses at Post program.

Model	Unstandardized Coefficients		Standardized Coefficients	t-test	P-value	90% Confidence Interval for B	
	B	Std. Error	Beta				
Constant	**208.248**	**20.875**		**9.976**	**0.000**	**165.951**	**250.544**
Knowledge score	.369	.120	.421	3.062	0.001**	.125	.613
Qualification	1.576	.688	.315	2.291	0.028*	.182	2.970

*: Significant at (p<0.05) **: Highly statistically significant at (p<0.01)

R-square=0.322 F: ANOVA= 8.778

Variables entered and excluded: age, gender, marital status, nursing experience and cardiac care unit experience

5. Conclusions

Based on the current study's findings, it can be concluded that there was a statistically significant improvement of nurses' knowledge and practice concerning HAMs after application of instructional module, which reflected on improved patients' outcomes through reduction in HAMs related complications post instructional module implementation for studied nurses.

Recommendations:

- Conducting continuous training programs and seminars focused on HAMs to enhance nurses' performance and the overall quality of care provided to this patient group.
- Ongoing monitoring of staff nurses' practices while caring for patients undergoing HAMs by head nurses and provision of guidance to correct inappropriate practices.
- Arabic brochure focused on HAMs with simple language and illustrative colorful images should be available to nurses' staff caring for patients undergoing HAMs.

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